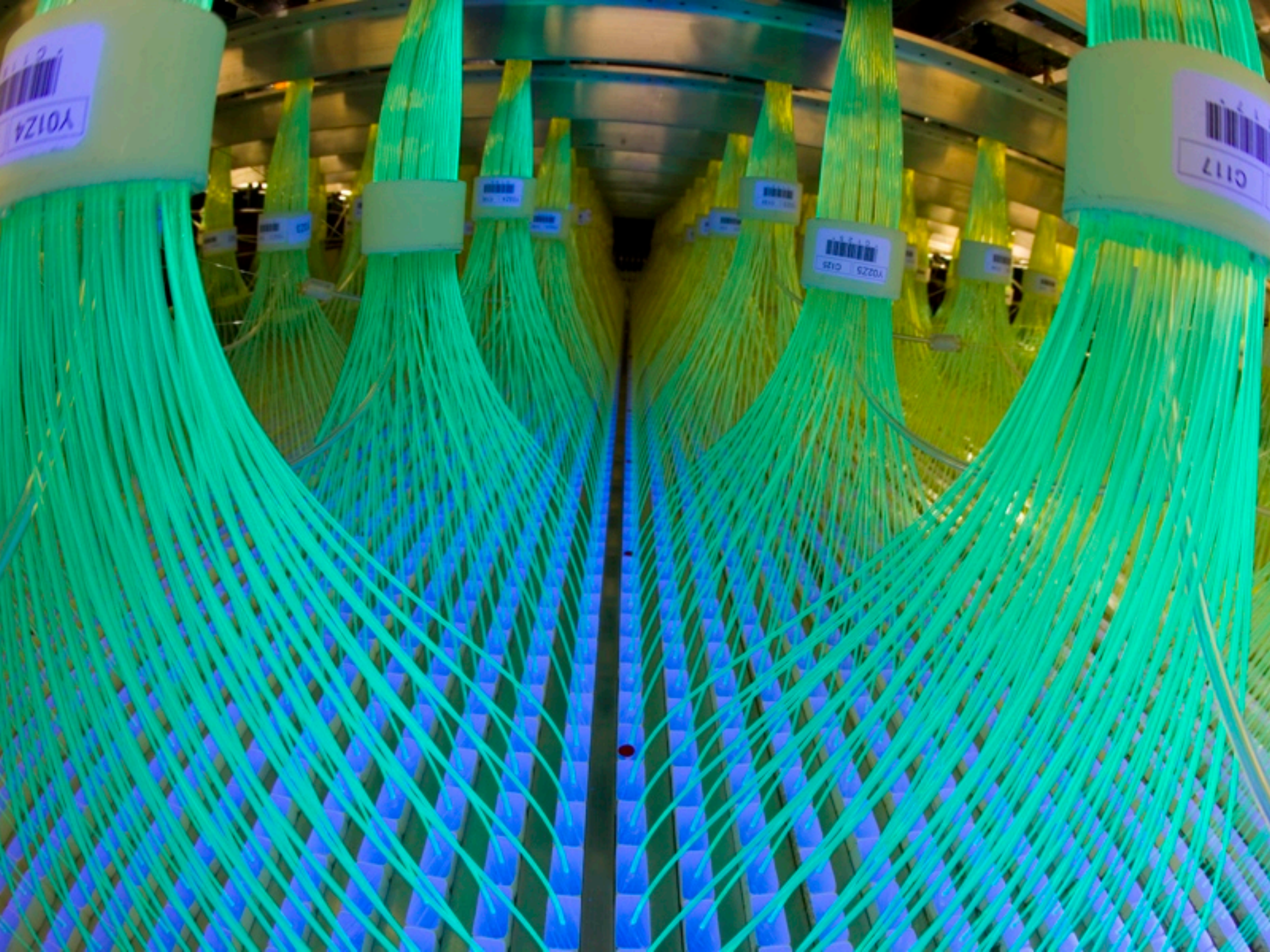


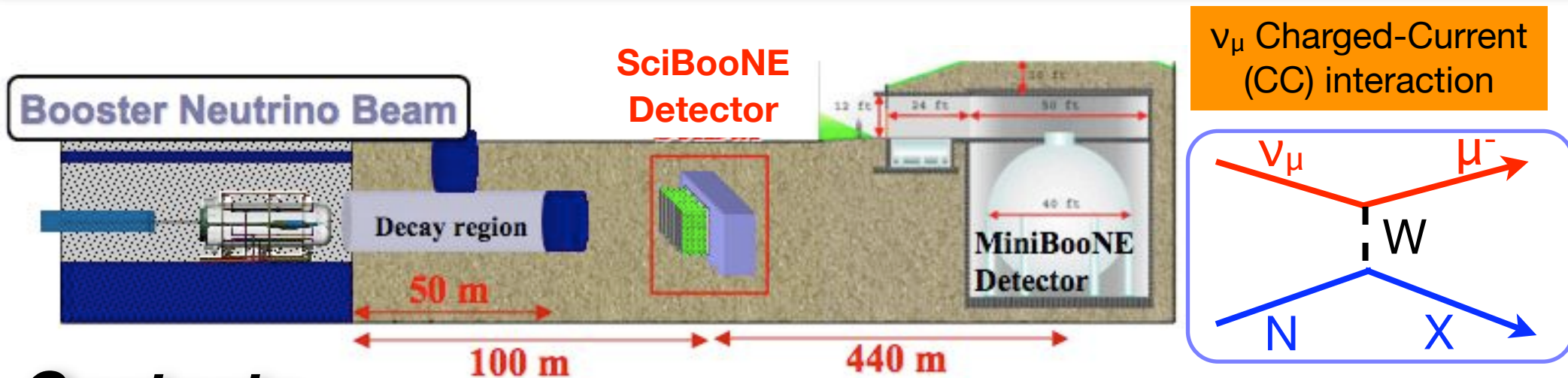
Measurements of neutrino charged current interactions at SciBooNE

Yasuhiro Nakajima (Kyoto Univ.)
for the SciBooNE collaboration

April 12th, 2008
APS08 Meeting at St. Louis, MO

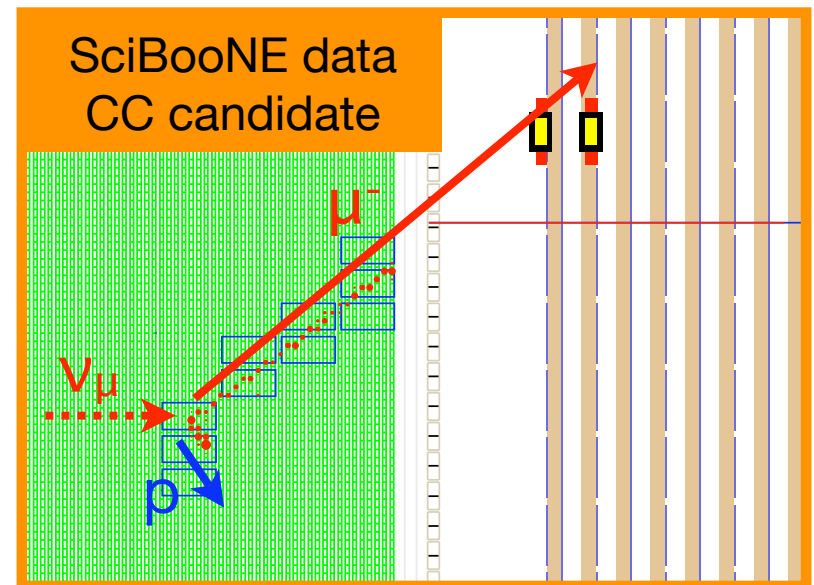


Overview



Contents

- *Motivation*
- *CC event selection*
- *Primary muon analysis*
- *Summary*



Motivation

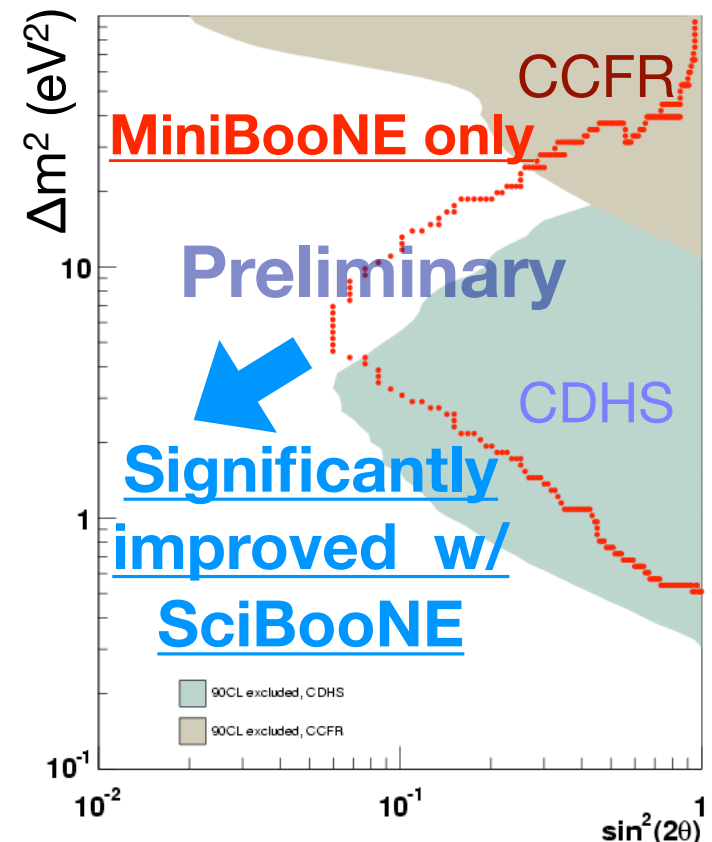
- Neutrino spectrum/flux measurements with small systematic uncertainties.
 - Very pure ν_μ CC sample by identifying muon.
 - Reconstruct neutrino energy from muon kinematics.

➔ Essential for any other exclusive cross-section measurements.

➔ Short-baseline neutrino oscillation search with MiniBooNE.

MiniBooNE+SciBooNE ν_μ disappearance search

- Sharing the beam line
- Same target: (SB: CH, MB: CH₂)



CC event selection (1)

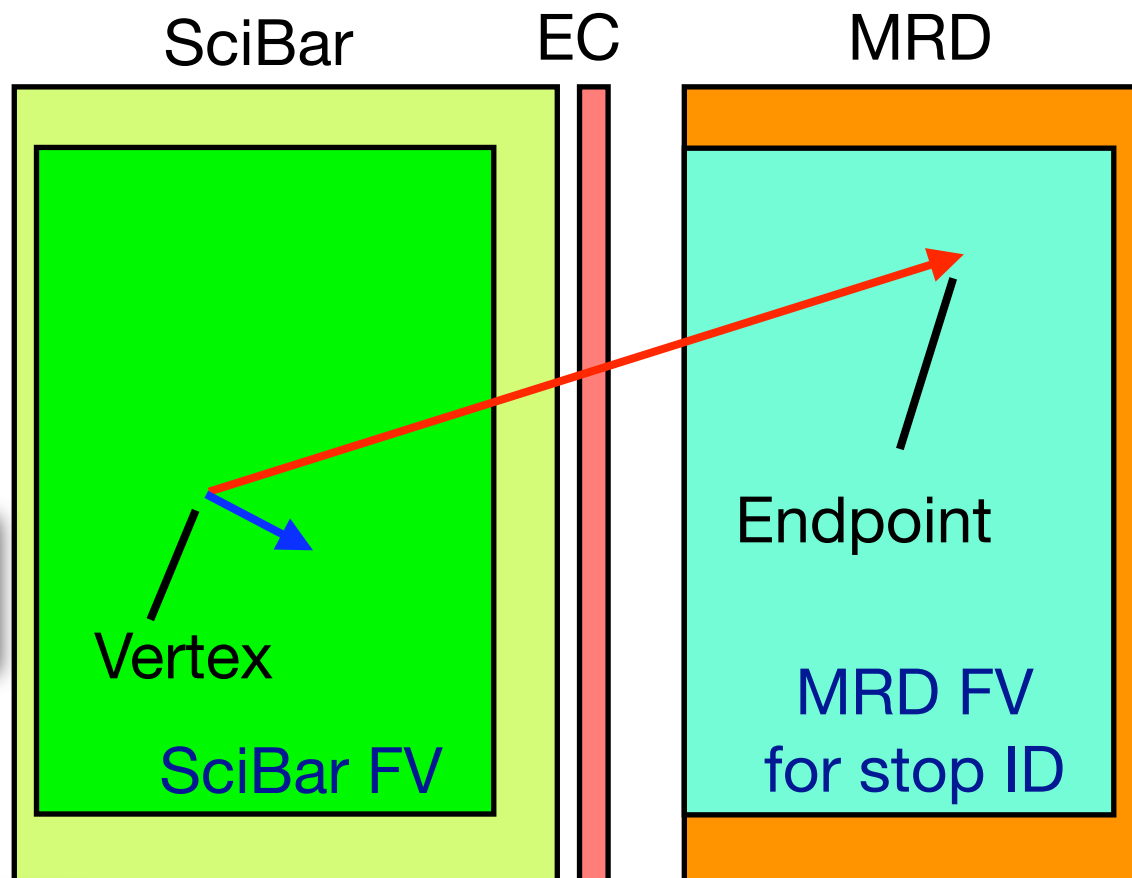
- Assume the longest track as muon track.
- Require the vertex is in SciBar FV(10 tons)

Track reaching to MRD

➔ MRD-matched event
Define data/MC normalization

Track endpoint contained in MRD

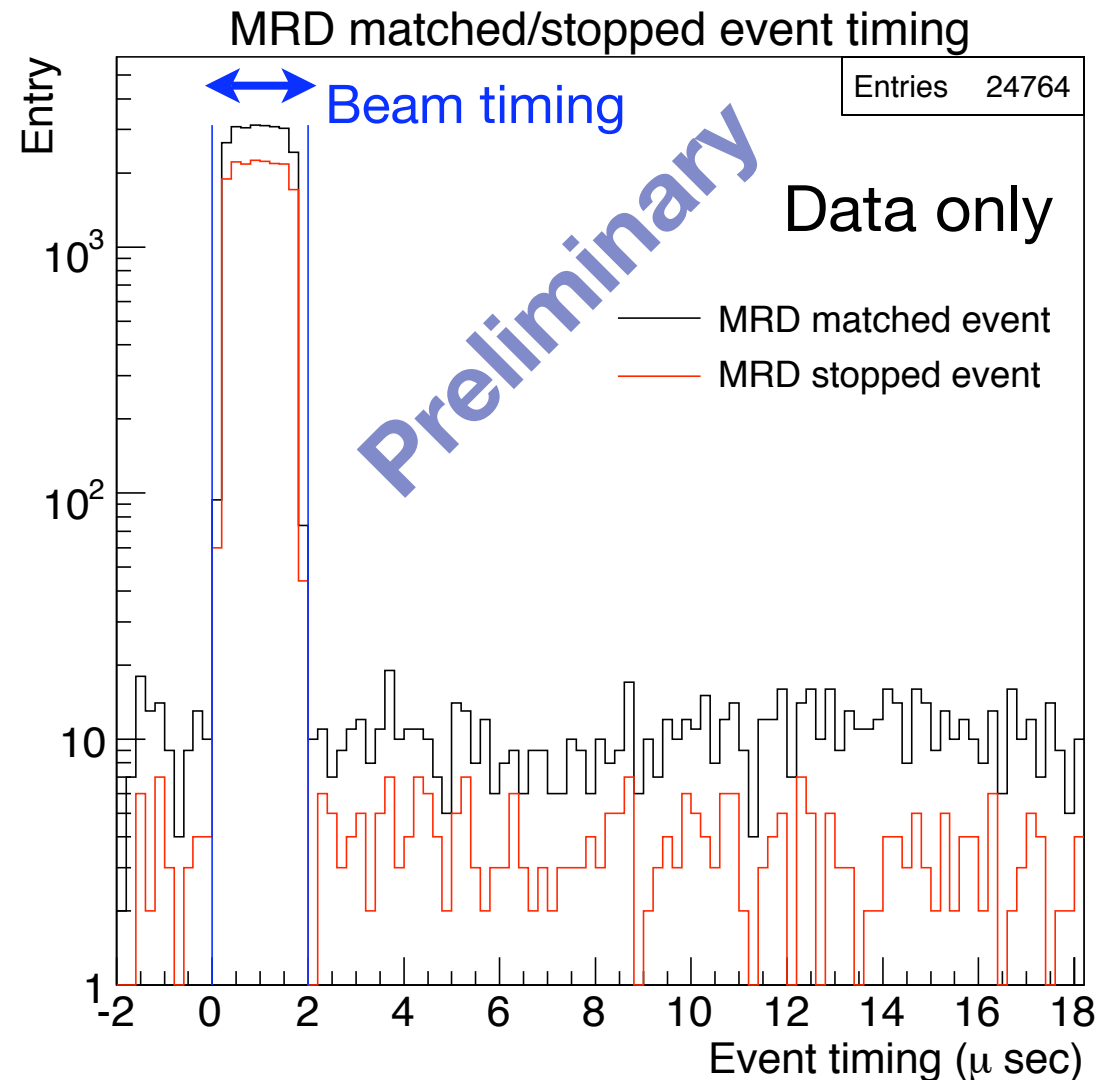
➔ MRD-stopped event
Used for momentum reconstruction



~96% pure CC sample

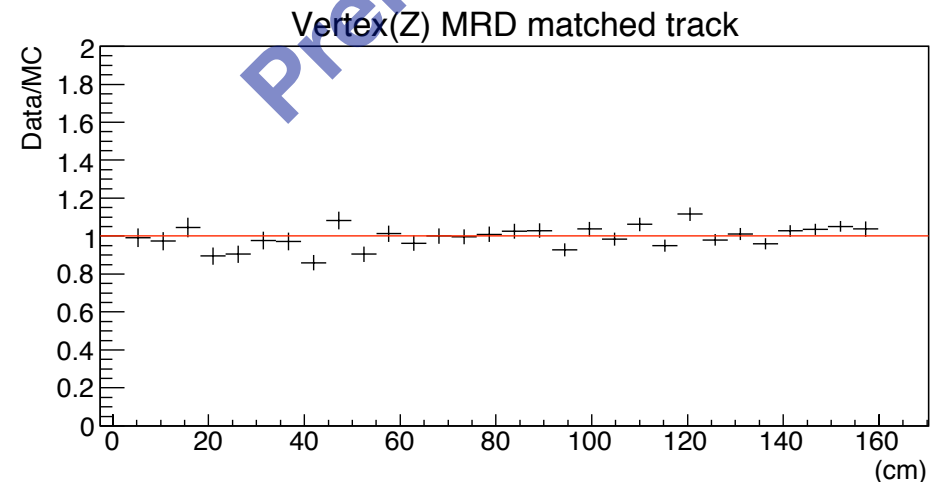
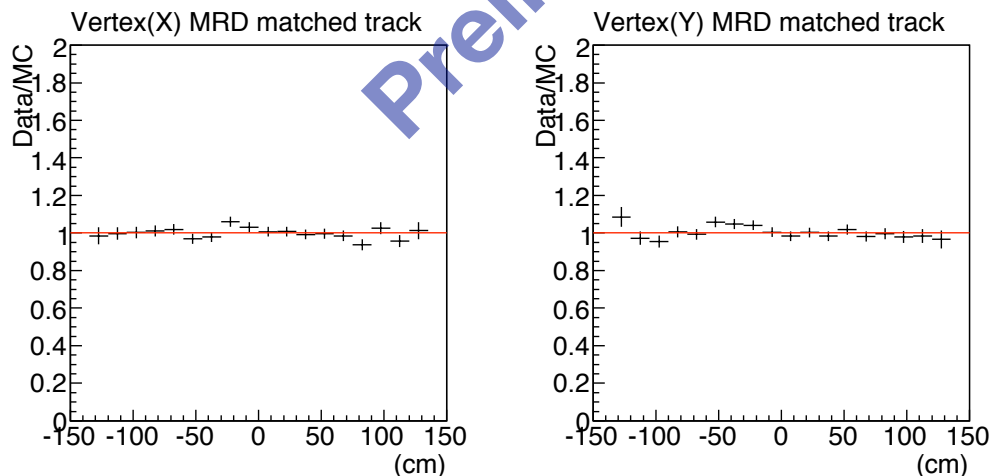
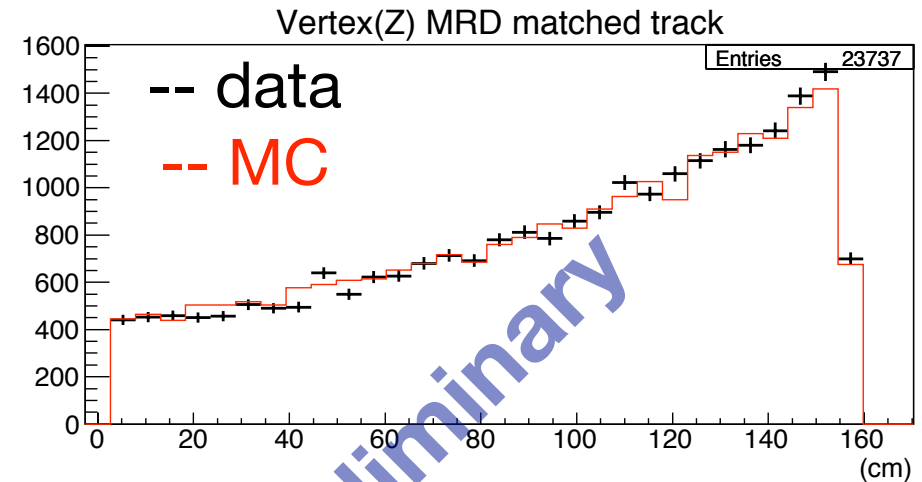
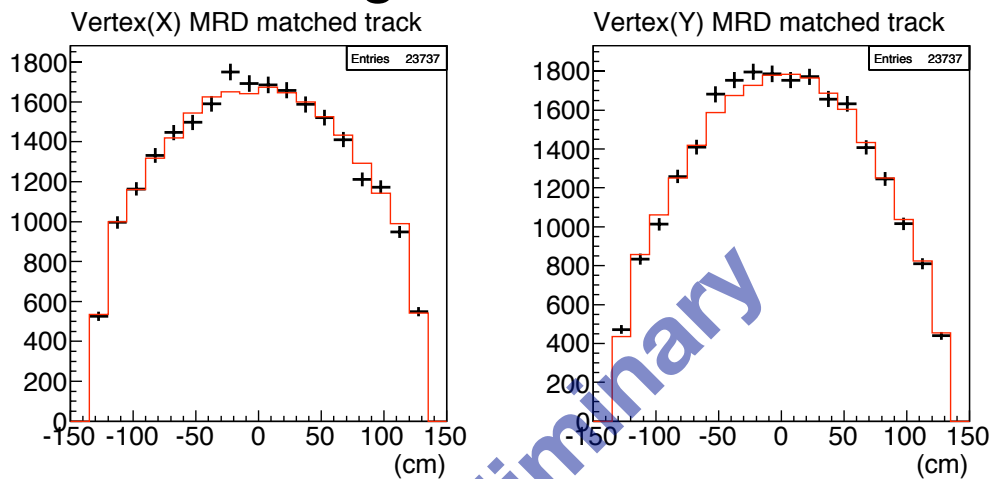
CC event selection (2)

- 2 μsec beam timing window.
 - Less than 0.5% cosmic background contamination.
- 7.67E19 POT (77% of collected) used for this analysis.
- 24K MRD-matched events.
- 17K MRD-stopped events.



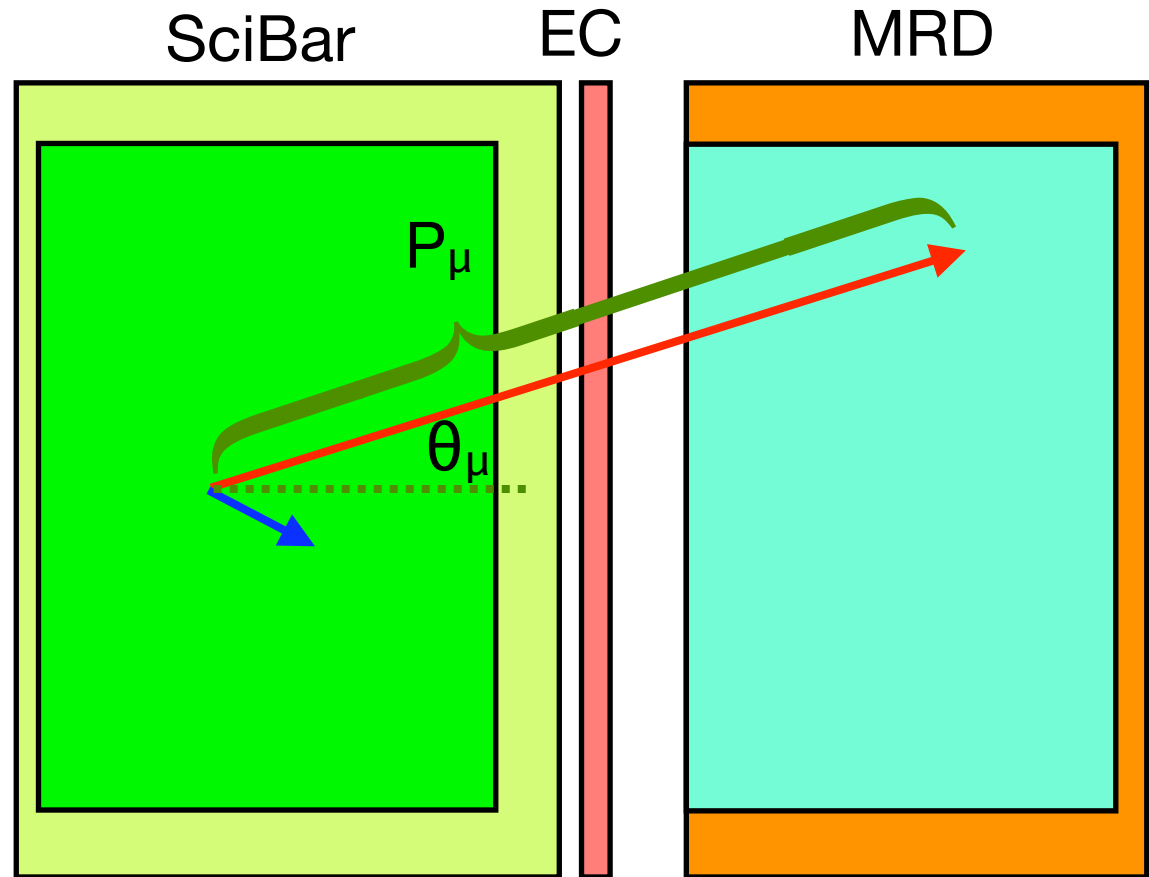
Vertex distribution

- SciBar-MRD matched event (Used for data/MC normalization)
- Data agrees with MC well.



Muon reconstruction

- Get muon angle w.r.t. the beam axis (θ_μ) from track direction in SciBar.
 - $\sigma(\theta) \sim 1.5$ deg.
- Reconstruct muon momentum (P_μ) with the track path-length.
 - $\sigma(P) \sim 50\text{MeV}/c$
(for $P \sim 0.8\text{GeV}/c$)
- E_ν and Q^2 can be reconstructed by θ_μ and P_μ only. (assuming CC Quasi-Elastic (QE) interaction)



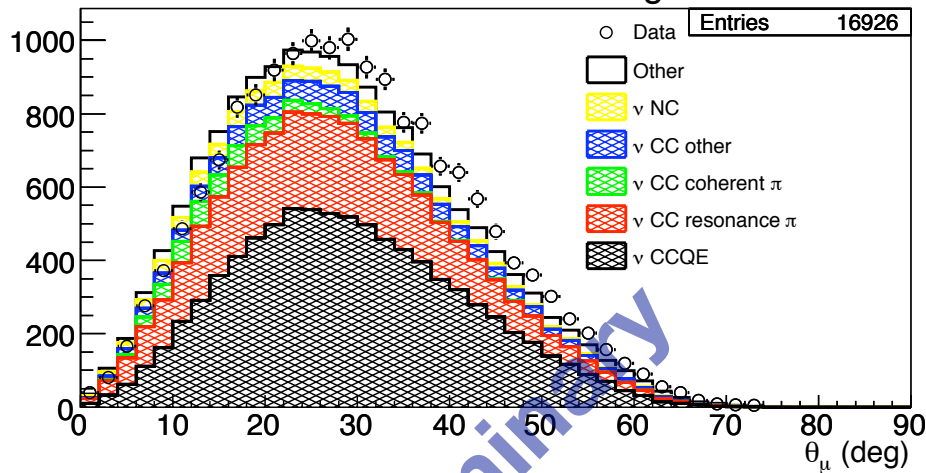
$$E_\nu = \frac{m_p^2 - (m_n - V)^2 - m_\mu^2 + 2(m_n - V)E_\mu}{2(m_n - V - E_\mu + p_\mu \cos \theta_\mu)}$$

$$q^2 = 2E_\nu(E_\mu - p_\mu \cos \theta_\mu) - m_\mu^2$$

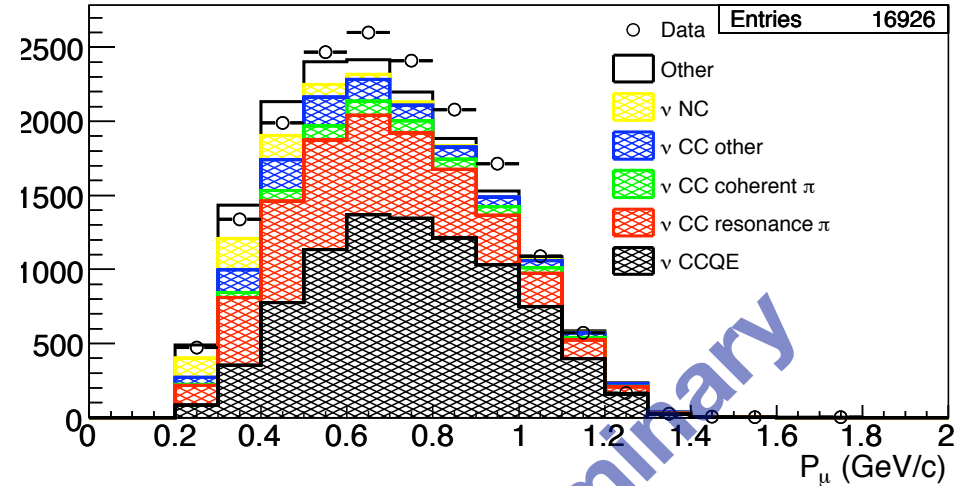
θ_μ , P_μ distribution

MRD stopped sample (normalization: SciBar-MRD matched sample)

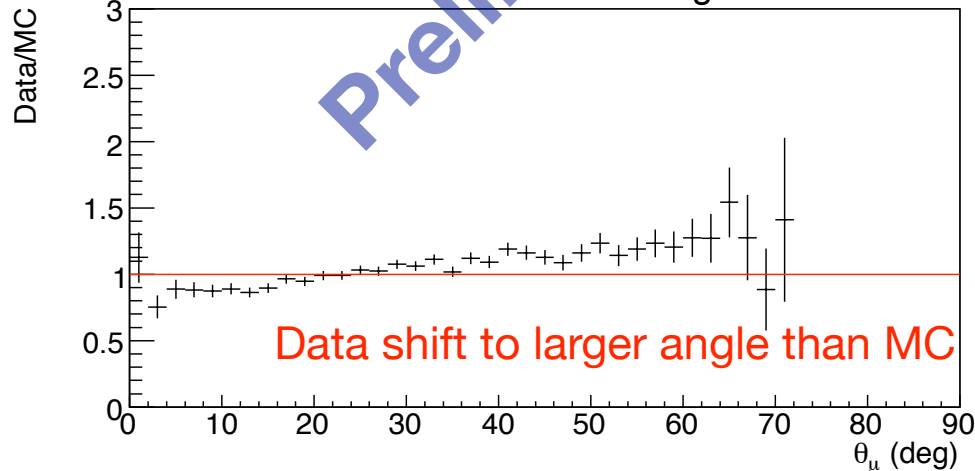
Reconstructed Muon Angle



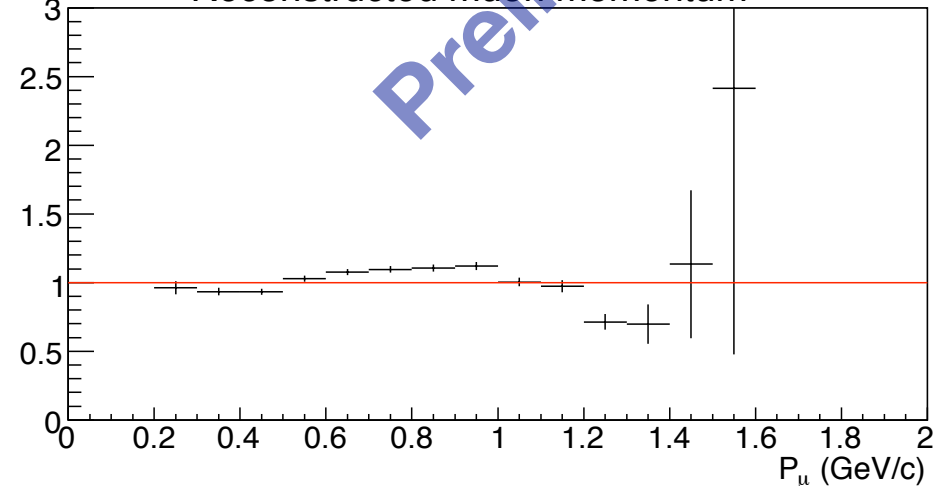
Reconstructed muon momentum



Reconstructed Muon Angle

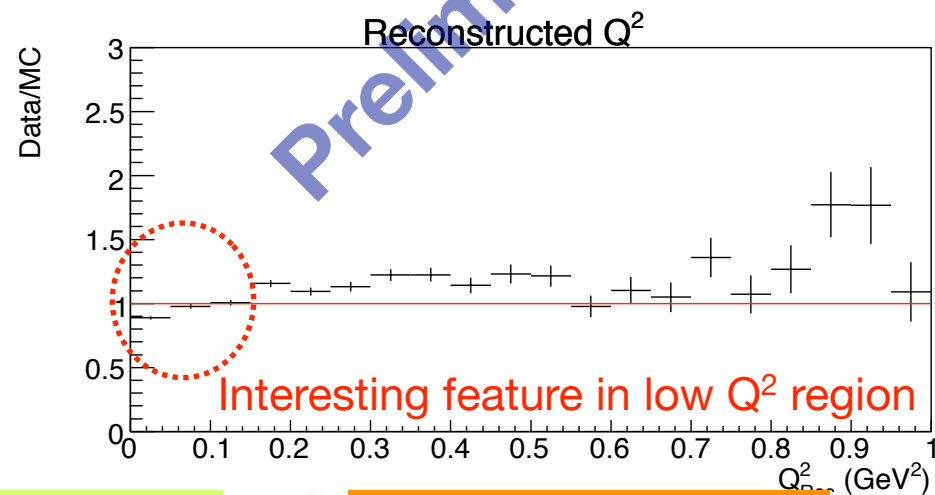
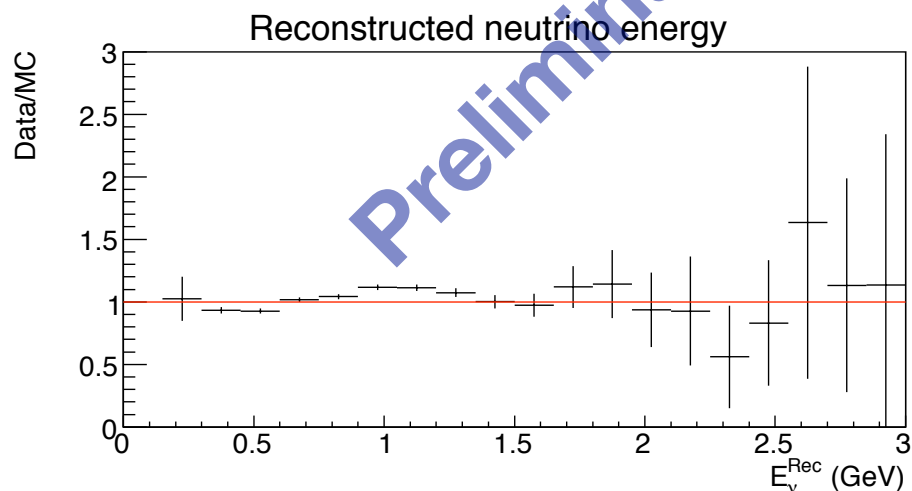
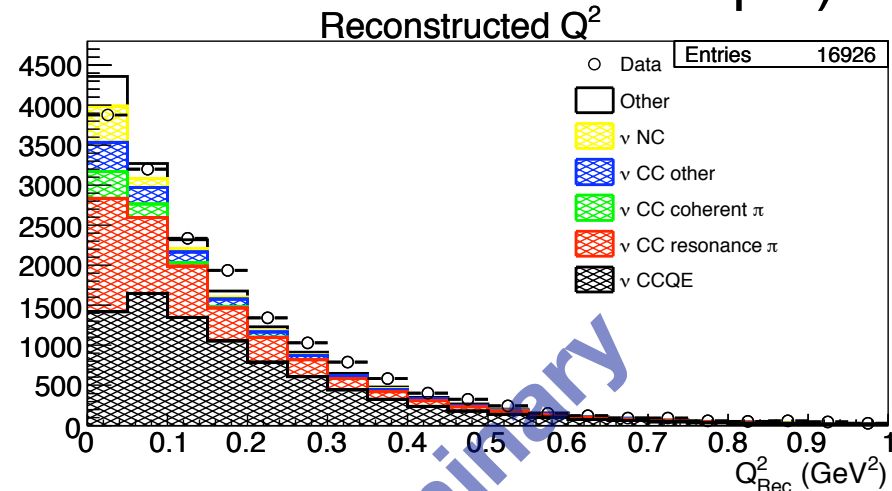
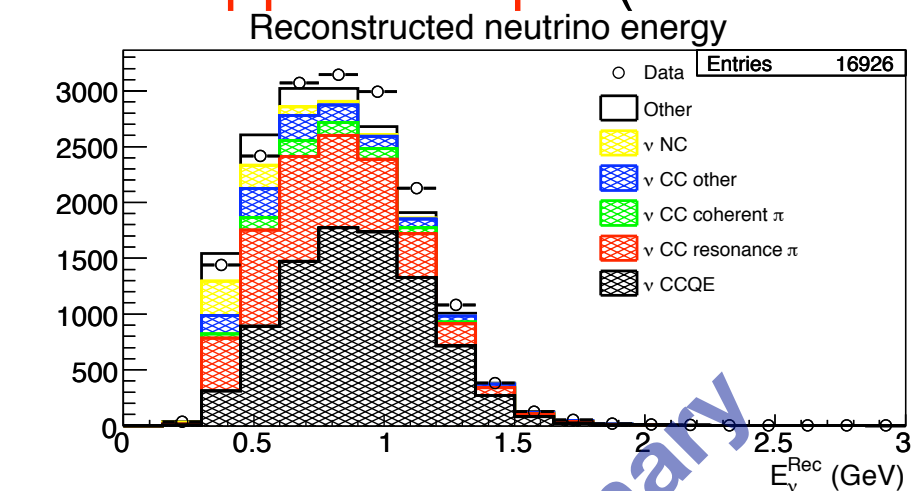


Reconstructed muon momentum



Reconstructed E_ν , Q^2

MRD stopped sample (normalization: SciBar-MRD matched sample)



Working on understanding muon distribution



Spectrum fitting

Summary

- Neutrino flux measurements using CC interaction.
 - Essential for any exclusive cross-section measurements and Short base-line neutrino oscillation search with MiniBooNE.
- High purity CC-sample by requiring SciBar-MRD matching.

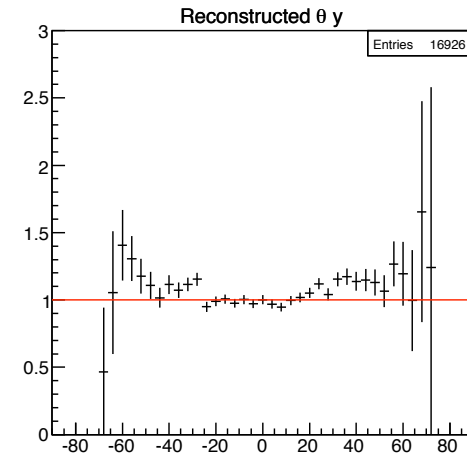
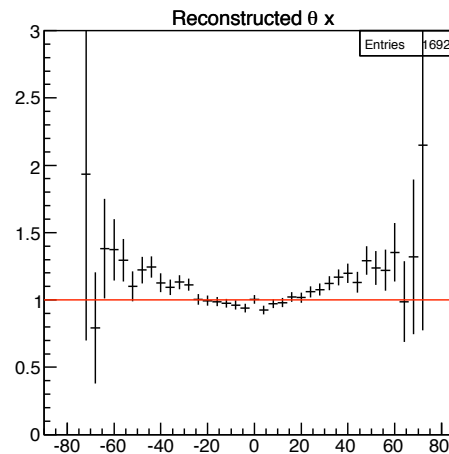
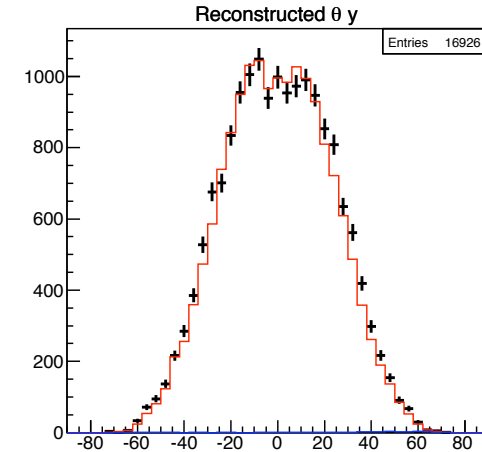
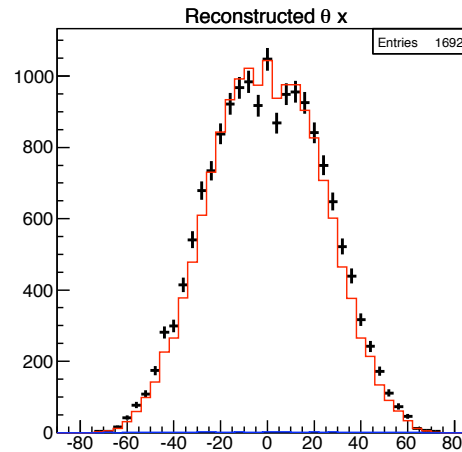
Working on

- Understanding muon distribution.
- Neutrino spectrum fitting.

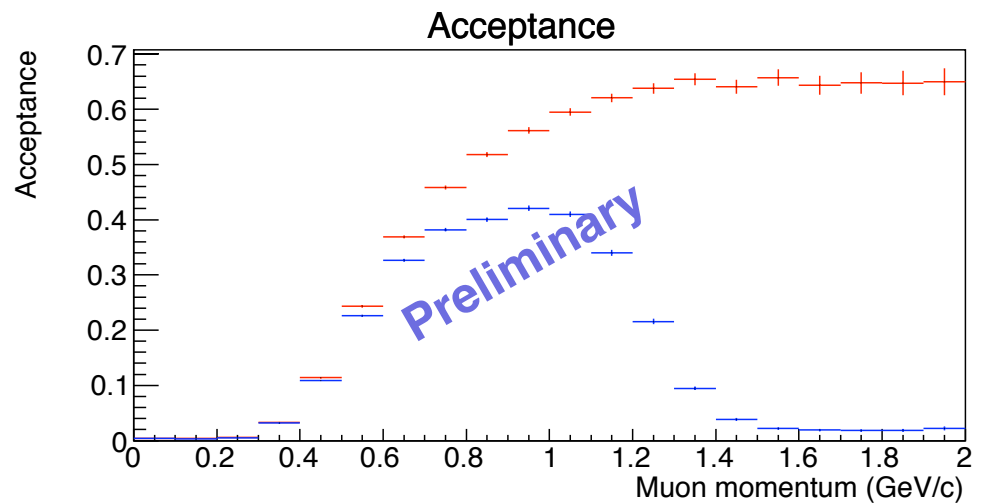
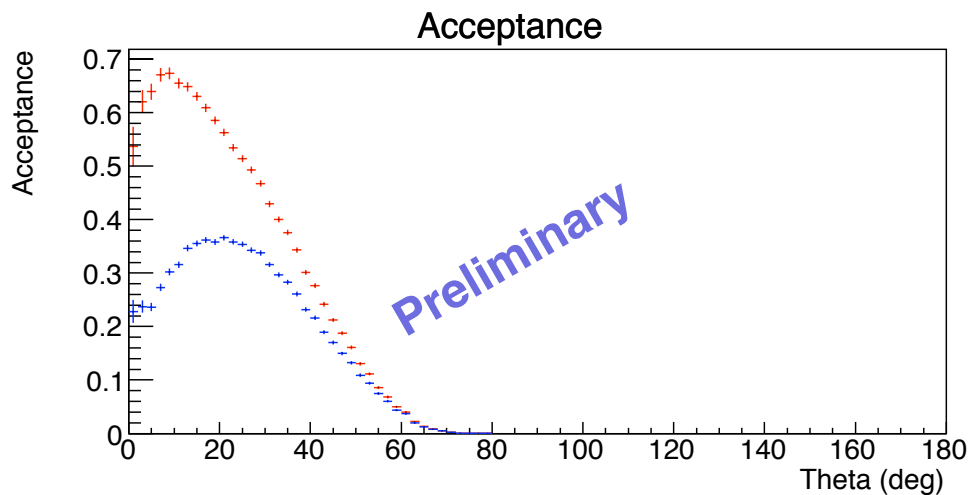
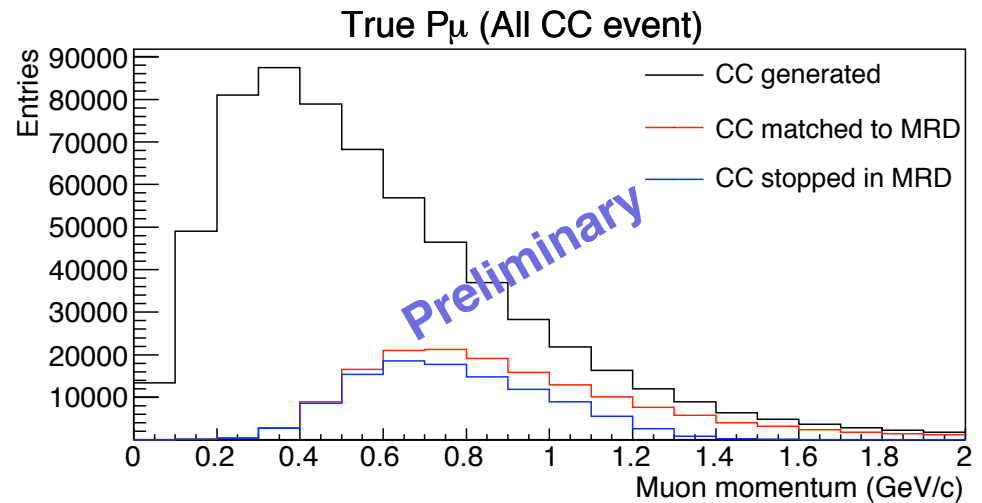
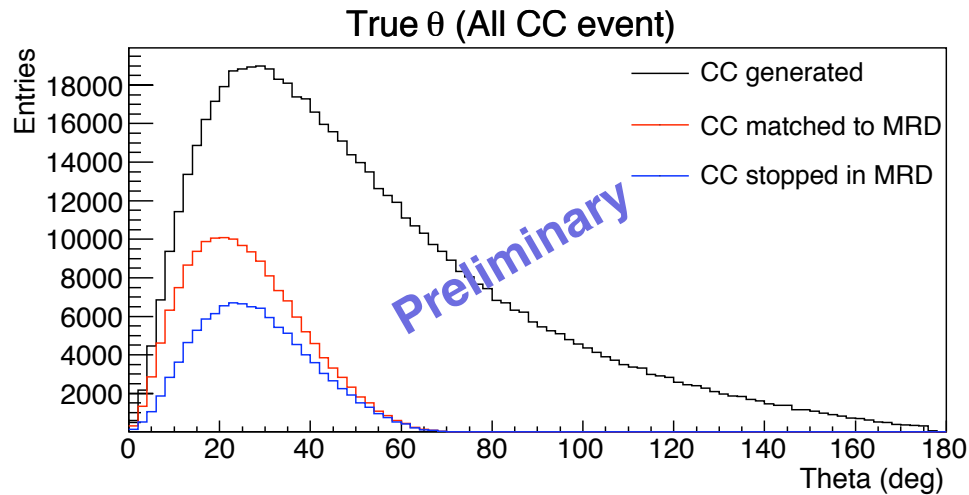
Backup Slides

Muon θ_x and θ_y

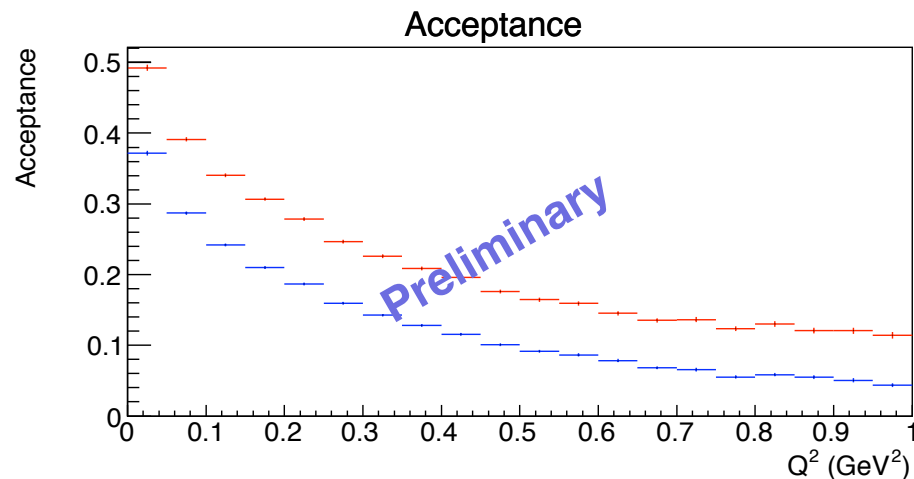
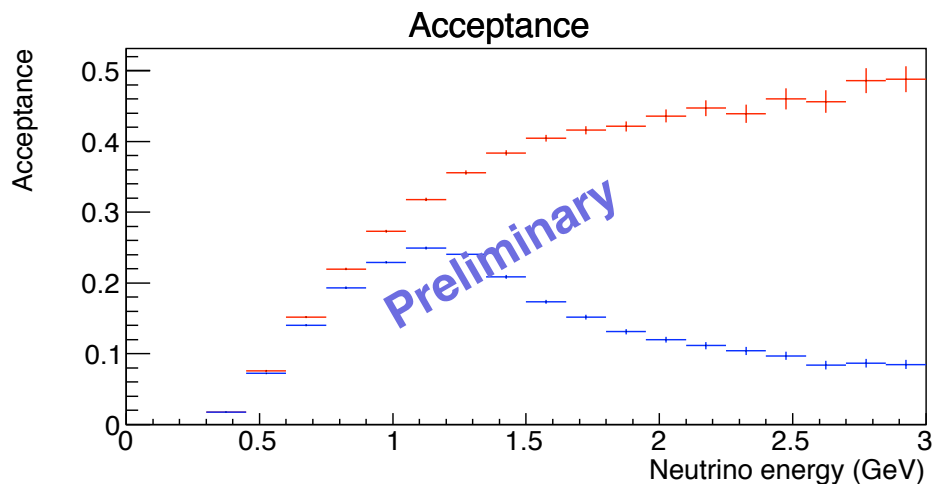
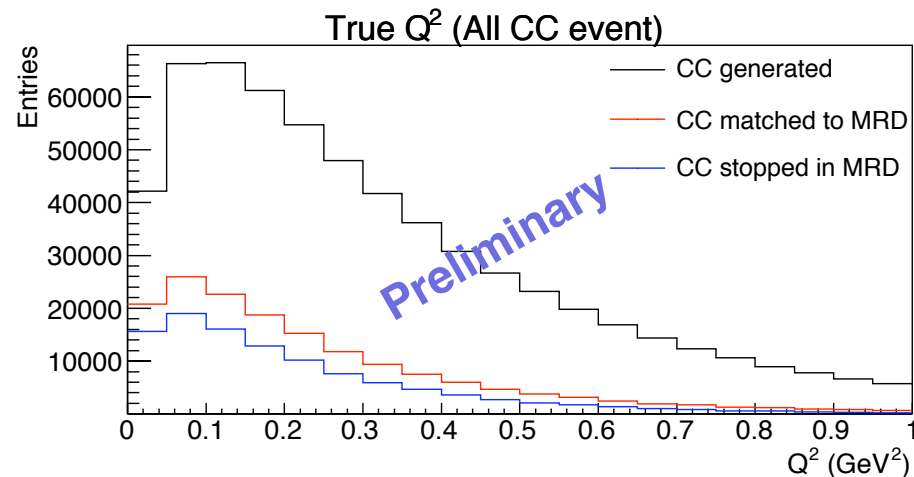
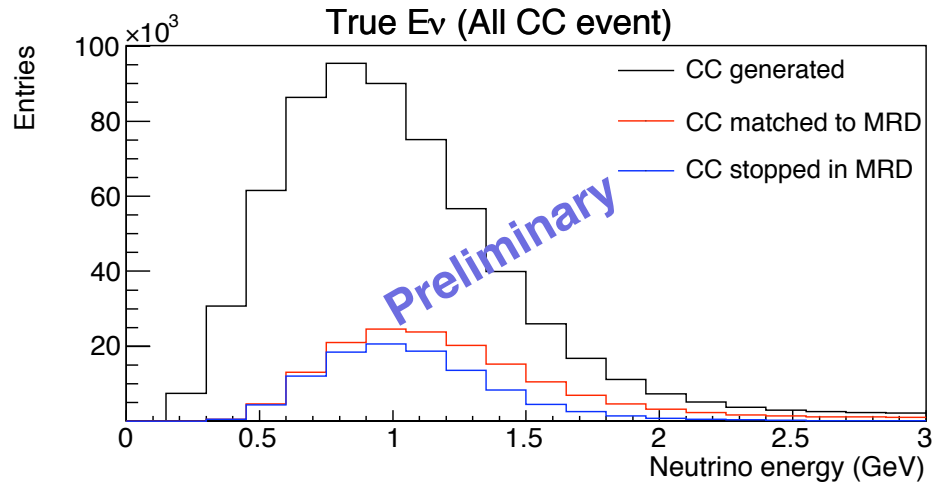
- Muon angle discrepancy can be seen in both X and Y directions.



Acceptance (theta, P_{mu})

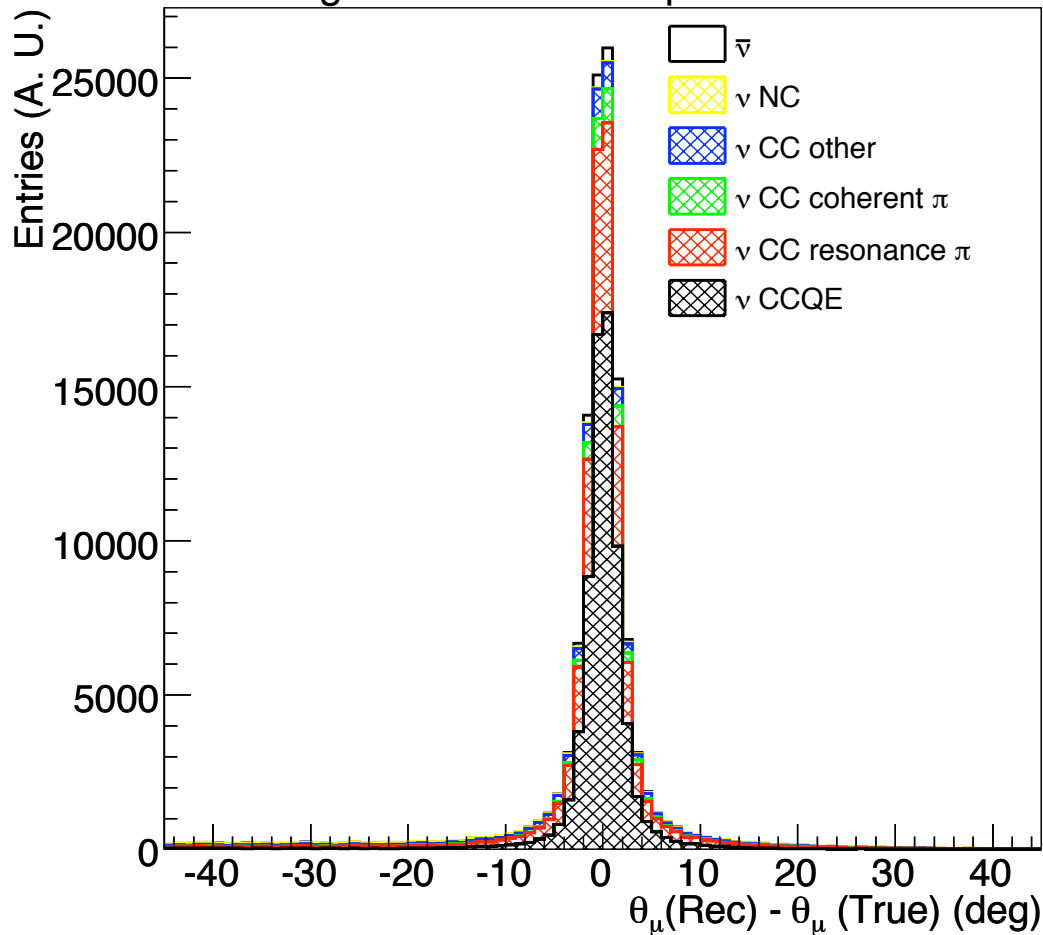
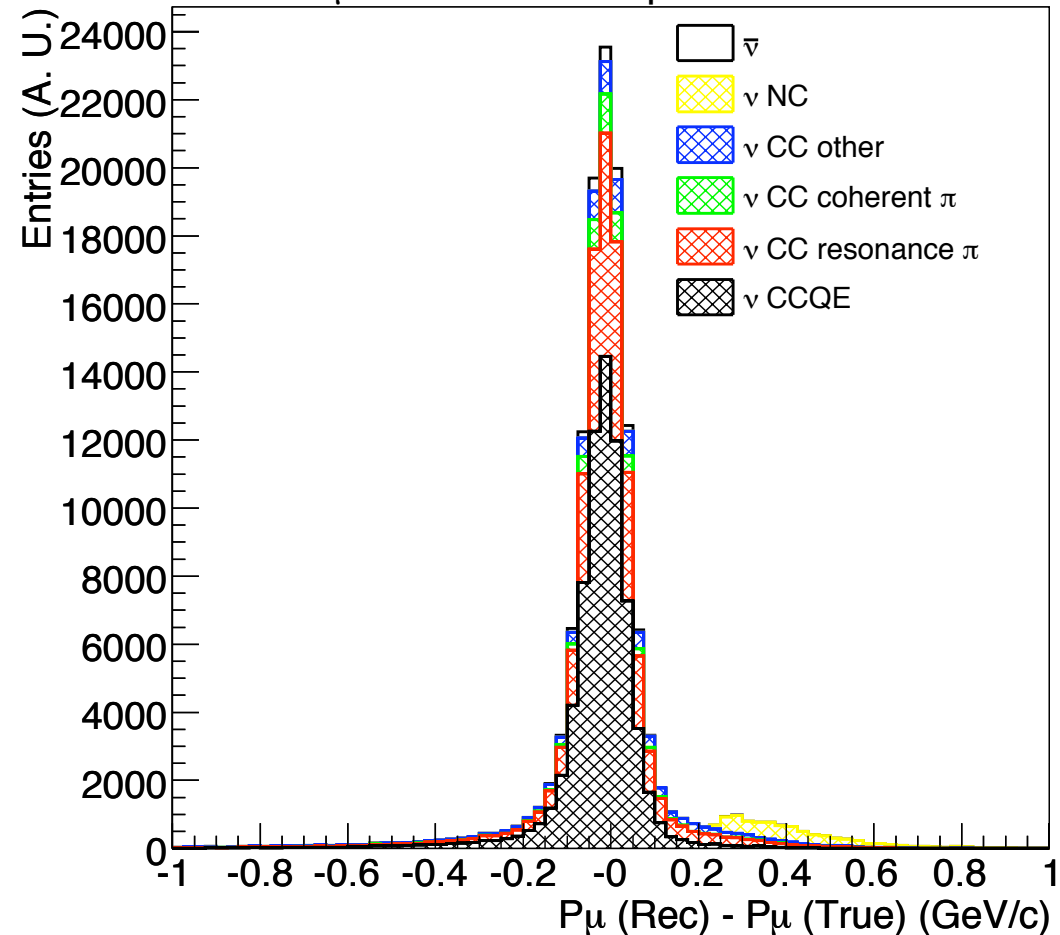


Acceptance (E_{ν} , Q^2)

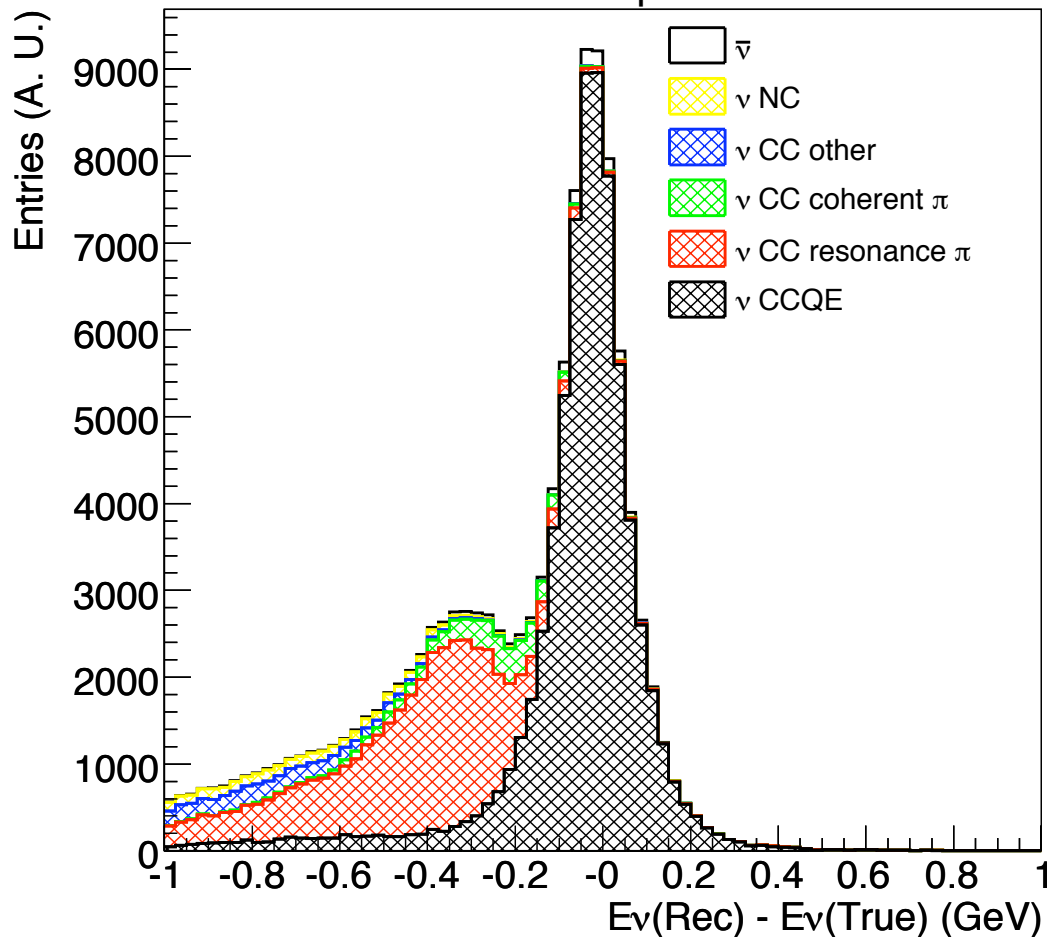
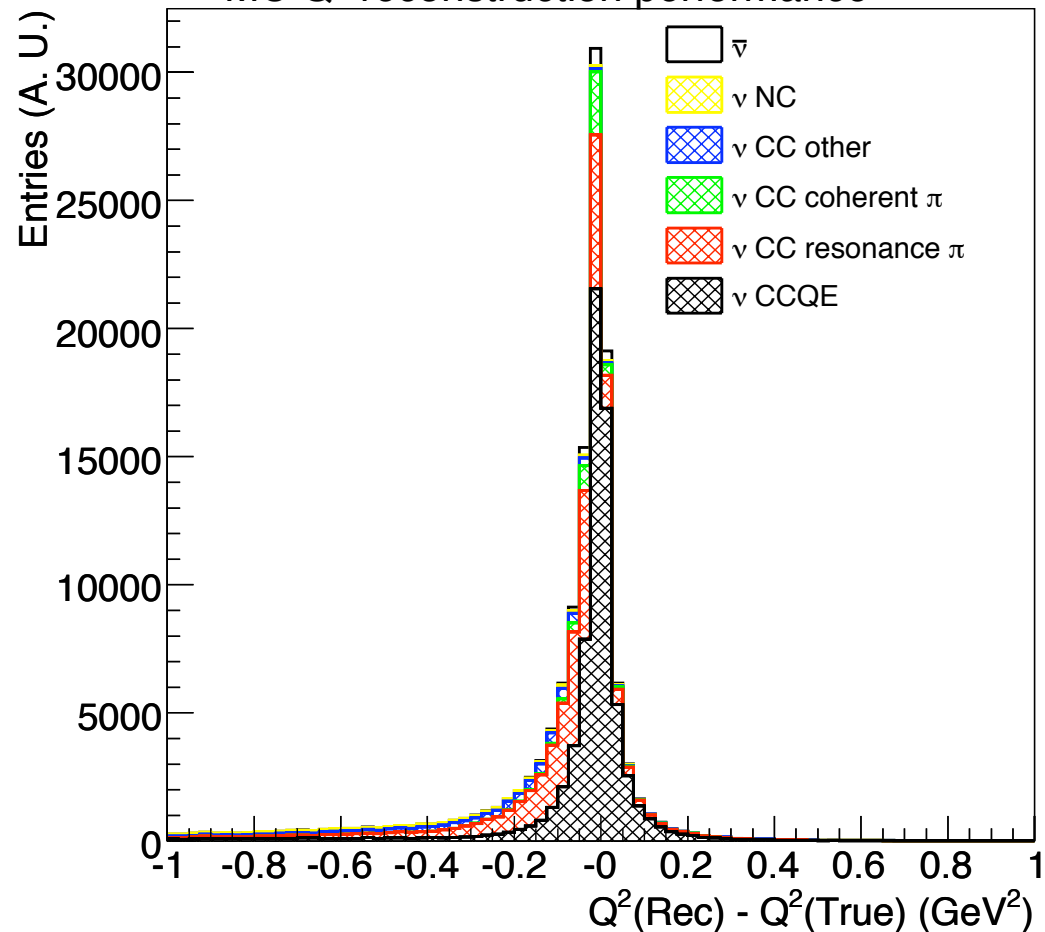


Angle, P_μ resolution

MC angle reconstruction performance

MC P_μ reconstruction performance

Enu, Q² resolution

MC E_ν reconstruction performanceMC Q² reconstruction performance

Angular discrepancy for MRD event

MRD

